A CONSTANT VOLUME RADIOCHEMICAL HOOD

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DESIGN PHILOSOPHY

In 1951, design criteria were being established for a new chemistry laboratory to be built by the California Research & Development Company, and studies were undertaken at that time to determine the type of radiochemistry hood that was to be used. The first requirement established was that the hood must be an integral part of a constant volume central exhaust system. Secondly, and opposed to a constant volume unit, it was desired to obtain a constant face velocity regardless of door setting. Lastly, it had to be inexpensive.

An examination of commercially available radiochemical hoods and those in current use at A.E.C. sites showed that none could meet our three demands. The problem was resolved by the designing of a hood that was formulated around several features:

1. To meet constant volume and constant face velocity -- which we set at approximately 100 FPM -- it was determined to use the hood door itself as an air regulating valve by incorporating a by-pass port directly above the hood compartment.
2. The exhaust filters were to be installed immediately adjacent to the hood outlet and at floor level to facilitate ease of change.
3. The hood must be readily portable and must pass through a standard 3'0" x 7'0" door.
4. It must be easily disassembled so that in the event of contamination only the affected part need be taken away.
5. It must be inexpensive.

How these features were achieved are to be illustrated by a look at the unit as it was designed and tested. (Refer to Figures I & II (Slides 1, 2, & 3))

GENERAL DESCRIPTION

The overall dimensions of the hood are 9'2" high by 4'3" wide and 2'10-1/2" deep, without front air foil -- with foil it is 3'1-1/2" deep. It is constructed throughout with mild carbon steel. The canopy and coverplates are of sheet metal and the supporting members utilize standard structural shapes. All surfaces that are exposed to either corrosion or contamination are finished with a baked phenolic resin. The hood opening is equipped with a removable air foil to insure smoother air entry.

The hood deck will support a floor loading of 500 pounds per square foot. Standard utility connections are provided, which includes a cup sink.

The hood section and the by-pass section both have a face area of 11 square feet; the hood window is likewise 11 square feet and as it is moved up or down the total air intake area remains at 11 square feet. With an average face velocity of 100 FPM, the volume remains at roughly 1100 CFM.

The air from both the hood and bypass compartments pass through the filter units at the base of the hood. A fiberglass prefilter is provided for each of two 2' x 2' x 5-7/8" CWS #6 (equiv.) filters connected in parallel. The total air volume in the unit can be adjusted by means of a butterfly damper located downstream from the filters. An indicating manometer shows the pressure drop across the filter bed, and as the filter loading increases the total air volume can be adjusted to a maximum of 3" static pressure drop across the filter bed.

The concrete slab construction of the building precluded any service basement so that a furred-in space is provided at the side of the hood for the utilities and duct run from the floor to the ceiling. Since two or more hoods are normally installed side-by-side, the common usage of the utility space is economically achieved. All valves and controls are mounted on the panel between the hoods.

The hood is quite simple to disassemble. The upper hood and by-pass section rests by gravity on the supporting structure. By disconnecting the utility outlets, the top section can be lifted off and taken from the room. The lower filter box and supporting structure can be removed by disconnecting a coupling to both water drain and to the air ducts.

The filters are changed by removing the cover plates and withdrawing the filters horizontally.

HOOD DEVELOPMENT

In order to ascertain the air currents, pressure drops, and general flow characteristics of the hood, a unit was mocked up to be run for smoke and velometer tests It was essentially as shown in Figure I and was used to determine optimum baffle, air foil and opening sizes. The unit was also used to determine the effect that each component had on the other.

In the original concept a simple vertical adjusting baffle was used at the back of the hood chamber. This demonstrated a very rapid increase in face velocity for the lower (hood) section as the door was closed. However, the total air volume remained fairly constant since the major pressure drop was concentrated at the narrow exhaust outlet between the hood and filter plenum.

To correct this increase in face velocity of the hood section, the vertically adjusting baffle was replaced by a hinged baffle which could be moved to decrease the air volume (--thus velocity--) in the lower hood section when the hood door was lowered. This mechanism works in this fashion: when the door is closed to 10" or less from the bottom, the operator may move the baffle to a partially closed position by pulling a handle on the control panel. The baffle locks in this position until the door is raised at which time it returns to its original position. If there is no objection to the higher face velocity, the baffle does not have to be closed. Figure III (Slide 4) shows this linkage in schematic fashion. Figure IV (Slide 5) shows the total volume and average face velocity of the hood in operation.

The use of the baffle showed that a more laminar flow of air was achieved with it than without it, and there was a minimum of hood turbulence regardless of door setting. There appeared to be no back-up of air from one compartment to the other, although, as would be anticipated, there was an increase in stagnated air in the bottom (hood) compartment as the door was lowered. Experiments with various sizes of air foils showed that there was little variation in effect due to size. However, the larger one performed better. The final radius was the maximum curvature to fit the physical installation limitations imposed by both building and personnel access. Slotted fairings were found ineffective at the relatively low velocities involved. It is well to state, however, that the flow patterns with the air foils were many times better than without: the overall air pattern was laminar with, but turbulent without, the foils.

HOOD LIMITATIONS AND COST

There are limitations, of course, to this type of hood. The most obvious one is that the number of hoods to a room is limited unless special air supply devices are used. This is due to the constant volume aspects of the hood.

The installed price by a commerical fabricator of fifteen units was approximately $1000 each. No attempt was made to determine the cost of a smaller number of units.

As in all initial designs, there are areas of improvement and we feel if additional units were to be built we would at least modify the following items:

1. Add a clamping bar on filter holders to facilitate holding.
2. Simplify baffle linkage.
3. Use counter weights on door instead of sash balances.

CONCLUSIONS

The hood has proven quite satisfactory in operation and we feel that the desirable features were obtained at a minimum of cost.

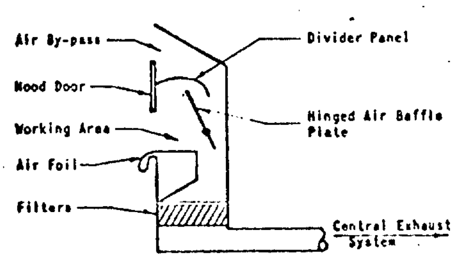
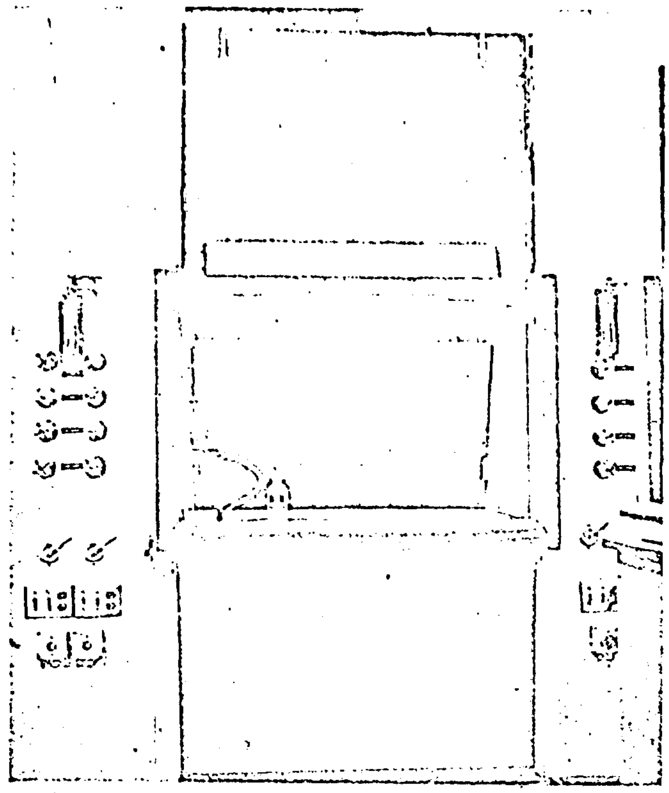
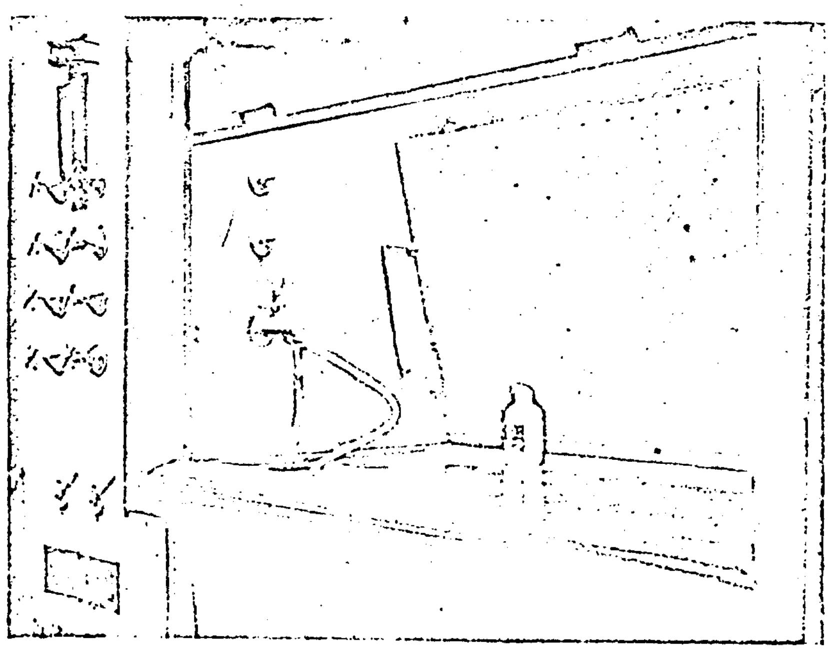


FIGURE I

SCHEMATIC DRAWING OF HOOD ELEVATION



a. Hood Installed



b. Close-up of Hood Installed

FIGURE II

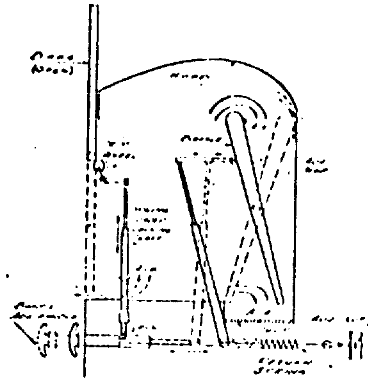


FIGURE III

SCHEMATIC DRAWING OF BAFFLE LINKAGE

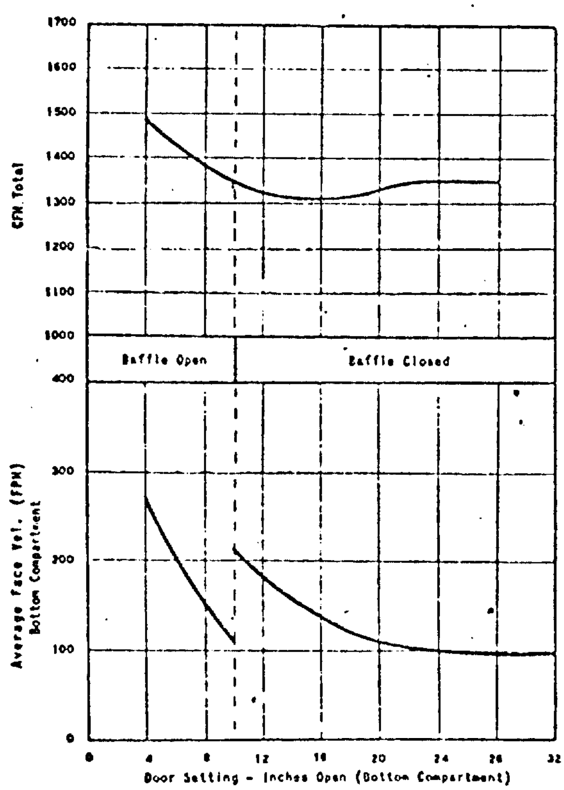


FIGURE IV

PERFORMANCE CURVES OF HOOD